March 31, 1942. A. P. BAMFORD ET AL 2,278,188

METHOD OF AND APPARATUS FOR DELIVERING SHEETS

Filed Aug. 3, 1940 4 Sheets-Sheet 1

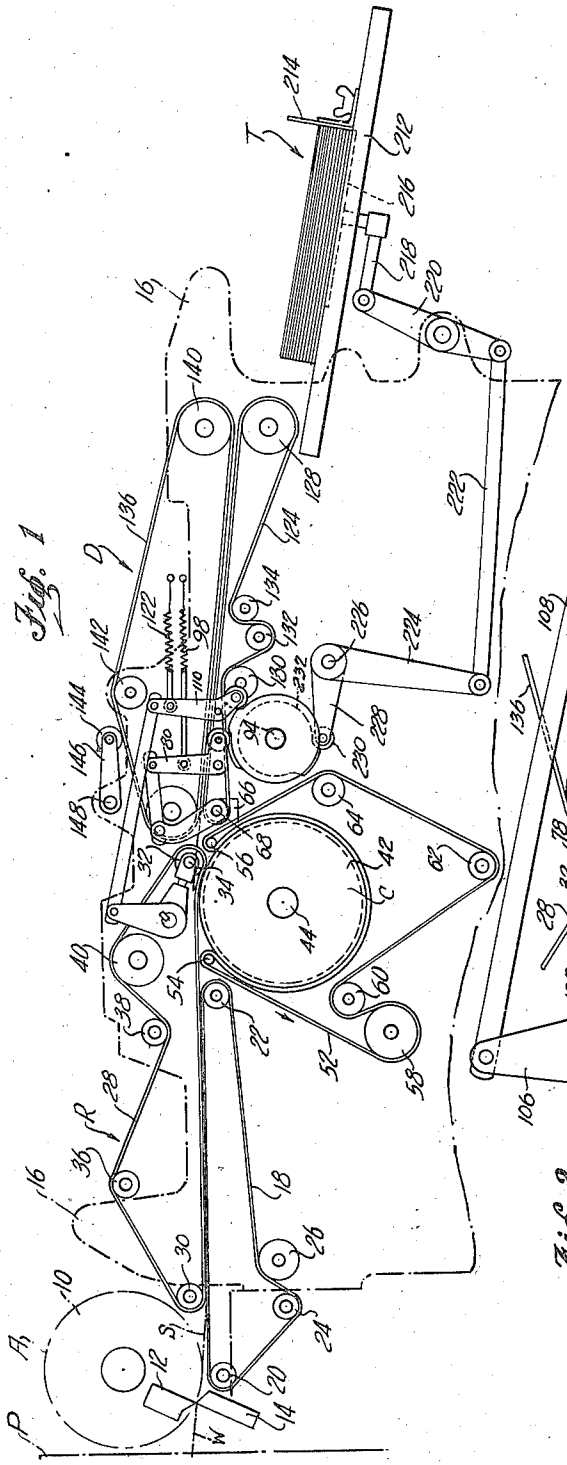


Fig. 1

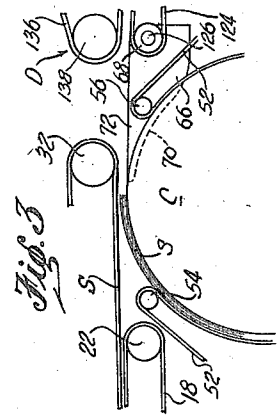


Fig. 3

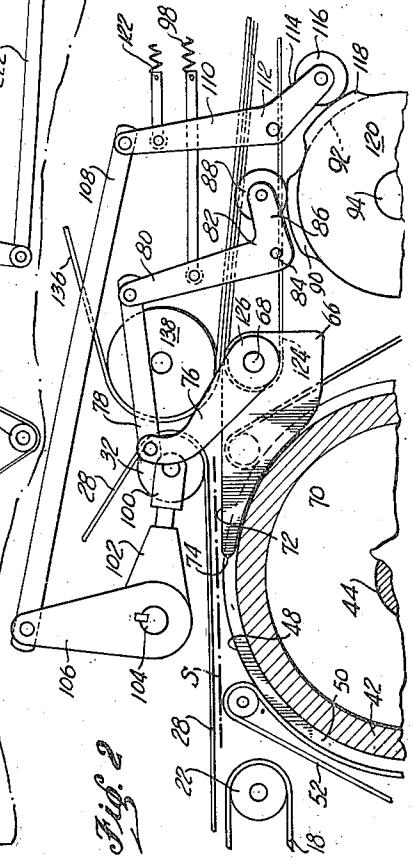


Fig. 2

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METHOD OF AND APPARATUS FOR DELIVERING SHEETS

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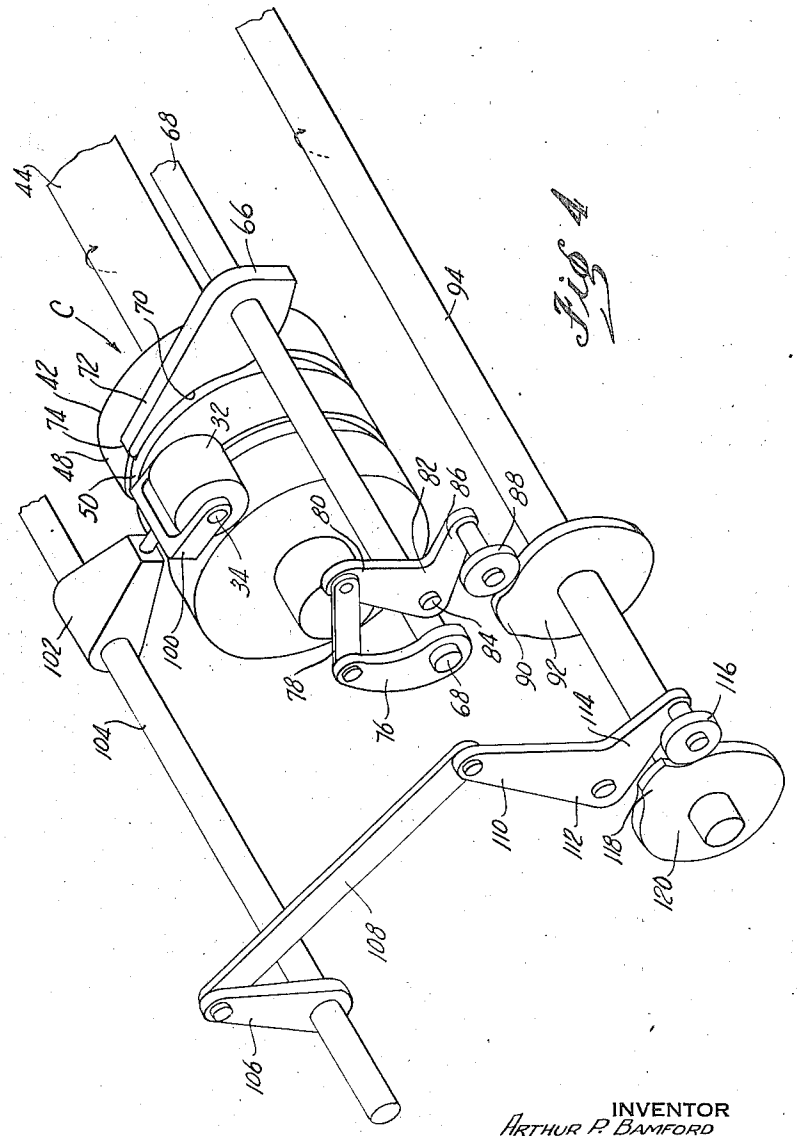



Fig. 1

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METHOD OF AND APPARATUS FOR DELIVERING SHEETS

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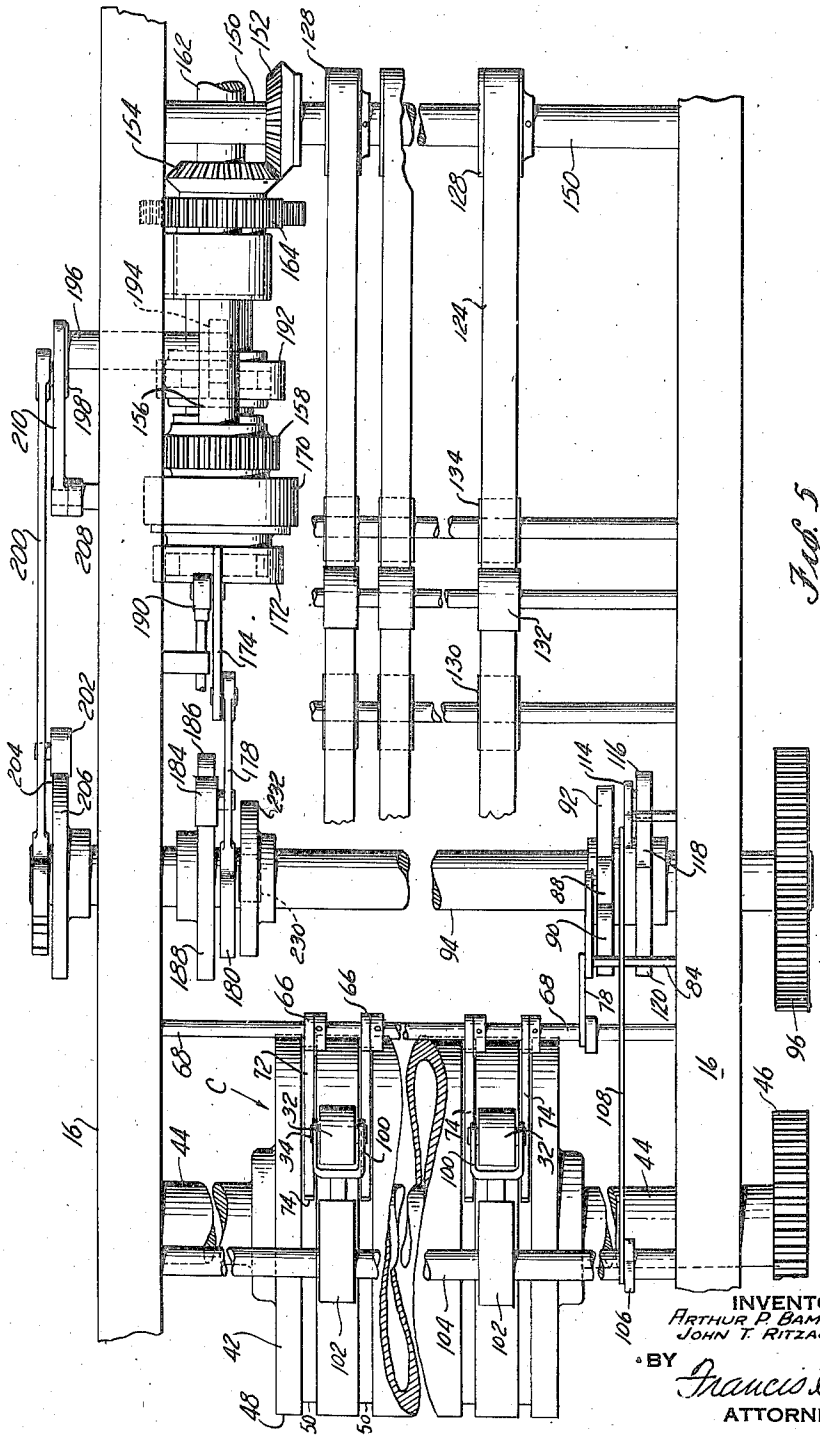


Fig. 5

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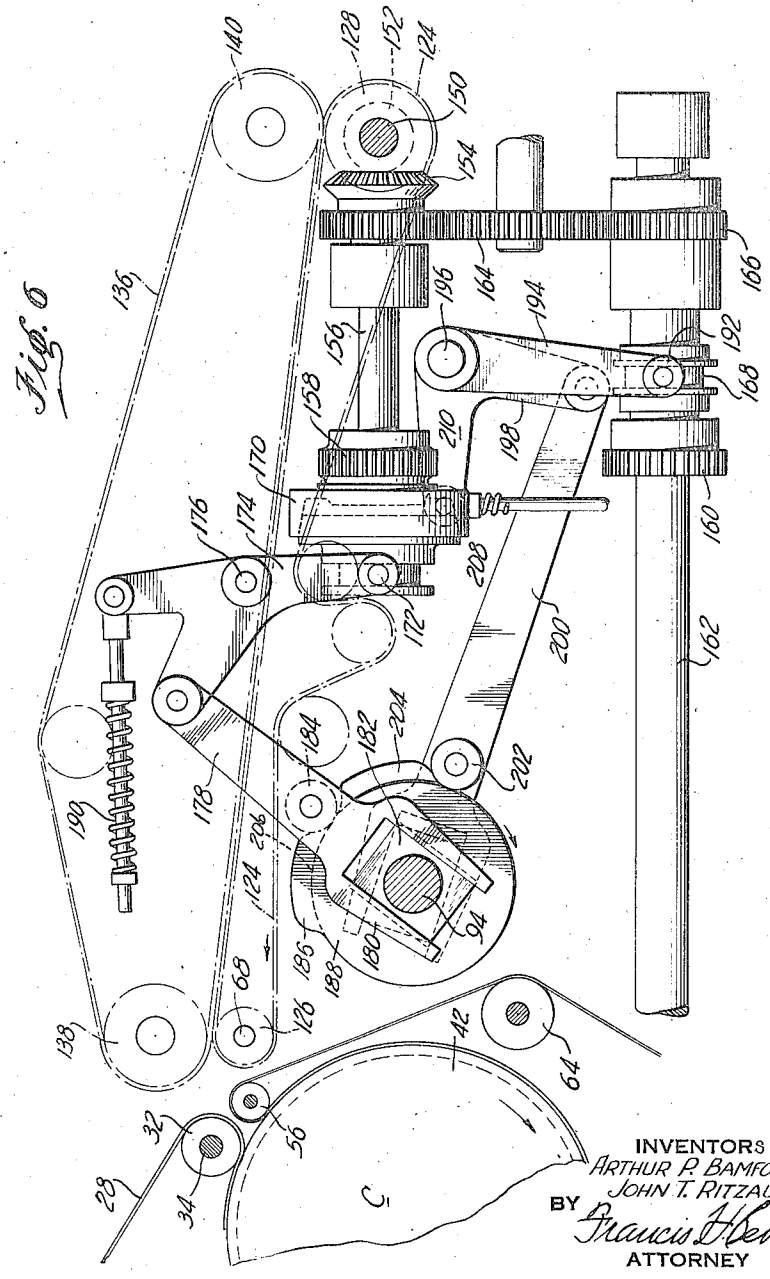
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METHOD OF AND APPARATUS FOR DELIVERING SHEETS

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Fig. 6




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Patented Mar. 31, 1942 2,278,188

# UNITED STATES PATENT OFFICE

2,278,188

## METHOD OF AND APPARATUS FOR DELIVERING SHEETS

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Application August 3, 1940, Serial No. 350,308

15 Claims. (Cl. 270—60)

This invention relates to delivery apparatus for rotary web printing presses and aims to provide an improved apparatus of this character which will function efficiently with a high speed rotary web printing press. More particularly, the invention contemplates the provision of a delivery apparatus which is adapted to receive and collect a plurality of sheets at normal press speed and then release the collected sheets and deliver them at a greatly reduced speed.

Recently great advances have been made in the construction of rotary web printing presses for the production of cartons, bags, wrappers, labels and the like (hereinafter referred to as the "commercial field") so that there are now available for this purpose rotary web printing presses which operate efficiently at speeds of from 400 to 600 feet per minute. With such presses a web of paper of from 20 to 36 inches in width may be printed in one or more colors with any desired label design, for example, and subsequently cut into sheets of any desired size. While press speeds of from 400 to 600 feet per minute are not uncommon in the publication field and sheeters, folders and delivery apparatus for this special field are available, these sheeters and delivery apparatus are not entirely suitable for the commercial field, with the result that many problems have been encountered in the handling of such printed materials produced at the high speeds now possible. For example, if the sheets cut from the web are of comparatively large size and thin paper stock, they tend to wrinkle readily and are of such light weight that they are very difficult to handle when delivered at high speed. Gravity alone cannot be counted on to move one delivered sheet out of the path of the next succeeding sheet. Moreover, due to the static electricity which accumulates in such sheets, the ordinary grippers and carrying cylinders cannot be effectively used.

We have found that the above and other difficulties encountered in the handling and delivering of comparatively large and thin sheets of printed paper may be obviated so that the sheets may be handled without wrinkling and delivered in a suitable vertically arranged stack from which they may be readily removed by the operator.

In accordance with our invention, the sheets cut from a freshly printed traveling web by any suitable type of rotary cutter are fed successively in predetermined spaced relation to a rotating collecting cylinder. The feeding means and collecting cylinder are rotated or operated at substantially the same speed as the printing press and cutter so that the sheets may be fed thereto and collected in any desired number, the number collected in any instance depending upon the speed of operation of the printing press and the maximum speed at which sheets of the size and weight then being treated may be effectively delivered. For example, if the printing press is operating at a speed of 400 feet per minute upon a paper web substantially 30 inches wide, we have found it desirable to collect ten sheets before passing them to the delivery part of the apparatus which, it will be understood, may be operated at substantially one-tenth the speed of the collecting cylinder and the printing press. Thus, by altering the number of sheets collected on the collecting cylinder, we are able to regulate the actual speed of delivery of said sheets.

The apparatus we have provided for accomplishing this desirable result may comprise a first set of receiving conveyor tapes arranged adjacent the rotary cutter and adapted to have the sheets fed thereto successively as they are cut. Should it be desired to have the sheets spaced for feeding to the collecting cylinder, the receiving conveyor tapes may be operated at a somewhat higher speed than the speed of the printing press. A collecting cylinder is positioned adjacent the receiving conveyor tapes in position to have the sheets fed thereto and held thereon by suitable sheet holding tapes. The size and speed of rotation of the collecting cylinder with respect to the speed of operation of the receiving conveyor tapes is such that the sheets will be collected and held thereon one over the other in a uniform stack. When nine sheets have been collected on the collecting cylinder and the leading edge of the tenth sheet is in register with the leading edge of the nine collected sheets, we have provided means for releasing all ten sheets and feeding them to a set of delivery tapes arranged adjacent the collecting cylinder at the delivery side thereof. Means are provided for rotating the delivery conveyor tapes at the desired delivery speed for actual delivery of a collected stack or group of sheets. However, means are provided for operating said delivery tapes at a speed substantially equal to the speed of the collecting cylinder and the receiving conveyor tapes for a length of time sufficient to permit the entire group of collected sheets to be removed or unloaded from the collecting cylinder. At the end of this time the speed of the delivery tapes is reduced to delivery speed and

the collected group of sheets are ejected upon a vertically forming stack at the exit end thereof.

The above and other features and objects of our invention will become apparent upon consideration of the following detailed description and the accompanying drawings, in which:

Fig. 1 is a diagrammatic side elevational view of one form of apparatus embodying the essential features of our invention;

Fig. 2 is a fragmentary view of a portion of the apparatus shown in Fig. 1, illustrating the details of the means for releasing the collected sheets so that they may be fed to the delivery conveyor;

Fig. 3 is a diagrammatic detail view showing the arrangement of the sheets as they are about to be unloaded from the collecting cylinder;

Fig. 4 is a detail perspective view of part of the apparatus shown in Fig. 2;

Fig. 5 is a plan view, with certain parts omitted and others in section for the sake of clarity, of the apparatus shown in Fig. 1; and

Fig. 6 is a side elevational view of a portion of the apparatus shown in Fig. 1, illustrating the detail of the driving mechanism for the delivery conveyor tapes.

We have chosen to illustrate our invention embodied in one practical form of apparatus for receiving horizontally disposed sheets, collecting ten of said sheets and delivering a group of ten collected sheets to a vertically forming stack at a speed of substantially one-tenth the printing press speed. It will be understood, however, that the apparatus may be adjusted and arranged to collect any desired number of sheets depending upon the size thereof and the speed of operation of the printing press.

Referring now to the drawings, and particularly Fig. 1, it will be observed that a web W which has been printed in any desired number of colors in a printing press P is fed therefrom in any conventional manner to a rotating cutting apparatus A which includes, in the form illustrated, an upper cutting cylinder 10 carrying a cutting blade 12 and cooperating with a lower stationary blade 14 so as to cut the traveling web W into a plurality of sheets S. Simultaneously with the cutting of the web into the sheets S, said sheets are fed into and gripped by a receiving conveyor R which forms the first section or stage of our improved delivery apparatus. This receiving conveyor R preferably operates at a linear sheet speed approximately 15% greater than the speed of movement of the web W through the printing unit and cutter A so that the sheets S will be spaced one from another as they are moved by the conveyor R to the second section or stage of the delivery apparatus which comprises a rotating collecting means or cylinder C. The collecting cylinder C is of such size and rotating at such a speed that it may collect a plurality of the sheets S on the surface thereof. In the form of the apparatus shown, when nine sheets have been collected in proper registry on the surface of the collecting cylinder C and the leading edge of the tenth sheet S is in line or register with the leading edges of the stack or group of collected sheets on the cylinder, the collected sheets will be released or unloaded from the collecting cylinder and passed or fed with the tenth sheet into a delivery conveyor D. The delivery conveyor D normally operates at approximately one-tenth the speed of the collecting cylinder C, but is constructed and arranged to be operated at the same speed as said cylinder during the time that the collected group of sheets is unloaded from said cylinder and fed to the delivery conveyor. When this is completed the speed is again reduced and the conveyor D feeds the collected group of sheets along a substantially horizontal path and ejects or releases them upon a delivery table T where they are formed in a substantially vertically arranged stack for ready removal by the operator.

As best shown in Figs. 1 and 5, our improved delivery apparatus including the receiving conveyor R, the collecting cylinder C, and the delivery conveyor D and table T, comprises a pair of spaced side frames 16, 16 mounted on a suitable base (not shown) and provided with bearings for the shafts of all of the rotating parts and supports for the various operating parts of the complete apparatus. The receiving conveyor R includes a lower set of endless belts or tapes 18. The operative or conveying reach of the tapes 18 extends from a set of left-hand supporting rollers 20, positioned beneath the cutting cylinder A and mounted on a shaft journalled in the side frames or an extension thereof, to a right-hand set of rollers 22 positioned adjacent the left-hand side of the collecting cylinder C and mounted on a shaft supported by the side frames 16. A third roller 24 and a driving roller 26 complete the support for the tapes 18 and any one or more of the rollers may be adjustably mounted for varying the tension in said tapes 18. Cooperatively mounted or positioned above the lower set of conveyor tapes 18 is an upper set of conveyor tapes 28 having an operative or conveying reach substantially the same as that for the lower tapes 18 but offset to the right therefrom and extending between a left-hand set of rollers 30, positioned to the right of the rollers 20 and adjacent the cutting cylinder 10, and a right-hand set of rollers 32 mounted on a movable shaft 34 positioned above and to the right of the center of the collecting cylinder C. Additional rollers 36 and 38 and a larger driving roller 40 complete the support for the upper sets of conveyor tapes 28. As with the lower sets of tapes 18, any one or more of the supporting rollers for the upper set of tapes may be adjustably mounted for varying the tension in the upper tapes 28.

It has been stated above that the set of conveyor tapes 18 and 28 comprising the receiving conveyor R is moved to provide a surface speed for the sheets S fed thereto from the cutter A which is approximately 15% greater than the speed of the web W through the printing apparatus P. This is accomplished by rotating the shafts of the rollers supporting the upper and lower sets of conveyor tapes 18 and 28, such as the shafts of the driving rollers 26 and 40, at the desired rotative speed, in any conventional manner, to produce such a surface speed for the sheets S. In this way, the sheets S will, in effect, be pulled away from the cutter A and, since moving at a greater surface speed than the web W, will be spaced one from another in their passage between the upper and lower conveyor tapes 18 and 28 so that they may be fed successively thereby to the collecting cylinder C.

Collecting cylinder C comprises a large cylindrical member 42 (Figs. 1, 2, 4 and 5) mounted on a shaft 44 journaled in suitable bearings provided in the side frames 15, 16 and having suitable driving gears 46 mounted on one end thereof for rotation of said cylinder at the desired speed. The cylindrical member 42 comprises a plurality

of cylindrical sections 48, corresponding in width and number with the width and number of conveyor tapes 28 and spaced from one another by a plurality of grooves 50. If desired, the outside surfaces of the cylindrical sections 48 may be knurled or otherwise roughened so as to provide proper frictional contact of the various conveyor tapes and/or collected sheets therewith. A set of conveying and sheet retaining tapes 52 is arranged in cooperative engagement with the cylindrical sections 48 of the collecting cylinder C. These sheet retaining tapes 52 are maintained in operative contact with the major portion of the cylindrical surface by a left-hand set of guide rollers 54, positioned between the rollers 22 and the cylinder surface, and a right-hand set of rollers 56 positioned directly adjacent to the rollers 32. The endless tapes 52 move at the same surface speed as the collecting cylinder C and, when said cylinder is rotating in a clockwise direction, said tapes pass from the guide rollers 56 around the surfaces of the cylindrical sections 48 to the rollers 54, then around a driving and/or guide roller 58, an adjustable guide roller 60 and guide rollers 62 and 64 which lead the tape back to the first set of rollers 56. All of said rollers 58, 60, 62 and 64 are postioned below the center of the collecting cylinder C and maintain the tapes 52 out of contact therewith.

In Fig. 1 it will be apparent that as the receiving conveyor tapes 18 and 28 feed a sheet S toward the collecting cylinder C, the operative reach of the upper tapes 28 which is in contact with the upper portion of the collecting cylinder will cause a sheet to be brought into contact with the cylindrical surfaces of the sections 48 so that the sheet will be fed between the tapes 52 and the cylindrical surfaces at the guide rollers 56 and will then be retained on the cylindrical surfaces by said tapes 52 and caused to rotate with the collecting cylinder C. This action and path of movement of each sheet S is further assured by means of a plurality of sheet guiding and unloading members 66 which are mounted on a shaft 68 positioned adjacent the shaft for the guide roller 56 (Fig. 1) and pivotally mounted in the side frames 16, 16. As shown in Figs. 4 and 5, each of the sheet guiding and unloading members 66 is provided with a lower curved section 70 corresponding substantially to the curvature of the cylindrical sections 48 and arranged directly above one of the grooves 50. The cylindrical portion 70 of each of the members 66 is normally positioned radially beyond the cylindrical surfaces 48 and extends preferably from a point directly above the center of the collecting cylinder C and to the left of the guide rollers 32 to a position beyond the guide rollers 56 (in the direction of rotation of the collecting cylinder C); and they thus provide surfaces which tend to prevent the leading edges of the sheets S from being deflected or otherwise moved from the surfaces 48 of the collecting cylinder. It will be apparent, therefore, that as the collecting cylinder C rotates at proper speed and the sheets S are fed thereto from the receiving conveyor tapes R they will be collected upon the surface one over another to form a stack or group of collected sheets which may subsequently be unloaded or delivered to the delivery conveyor D.

To unload a group of collected sheets from the surface of the collecting cylinder C at the proper time and insure their passing to the delivery conveyor D, we have provided mechanism for moving the guiding and unloading members 66 into the associated grooves 50 and moving the guide rollers 32 to an upper position out of contact with the surface of the collecting cylinder. When these movements take place the parts will assume the positions shown in Fig. 2, where it will be observed that the sheet guiding and unloading members 66 are provided with flat upper guiding surfaces 72 which terminate at the left-hand end thereof in curved guiding fingers 74, and the sheets S will thereby be caused to pass over the guiding surfaces 72 to the delivery conveyor D.

For effecting the movement of the sheet guiding and unloading member 66 into the grooves 50 of the collecting cylinder, the shaft 68 for said member 66 has a crank arm 76 mounted thereon and extending upwardly therefrom. The upper end of the arm 76 is pivotally connected by means of a link 78 with an upper arm 80 of a bell crank lever 82. Bell crank lever 82 may be pivoted at 84 to the side frame 16, or mounted on a suitable shaft supported between the side frames, and is provided with a substantially horizontally disposed arm 86 for carrying a cam roller 88 which is adapted to be actuated by a high point or actuating surface 90 provided on a cam 92. Cam 92 is mounted on a cam shaft 94 which is journaled in suitable bearings provided in the side frames 16, 16 (Fig. 5) and at one end thereof extends beyond the side frames where it may be provided with suitable driving means 96 for rotating said cam shaft 94 at the desired speed. This speed, as has been mentioned above, depends upon the number of sheets to be collected upon the collecting cylinder C and, in the present instance for the collection of ten sheets, will be approximately one-tenth the speed of rotation of the shaft 44 of the collecting cylinder C. The high point 90 of the cam 92 is positioned to cause the bell crank lever 82 to be turned in a counter-clockwise direction so that the members 66 will be moved into the grooves 50 when nine sheets have been collected upon the collecting cylinder and the leading edge of the tenth sheet is in register with the leading edge of the nine collected sheets, as shown in Fig. 3. The length of the high point 90 of the cam 92 is such that the parts will be maintained in the Fig. 2 position until the collected sheets are completely removed from the collecting cylinder C and are moved beyond or to the right of the roller 32. Then the parts may be moved back to the Fig. 1 normal position, such as by the action of a suitable spring 98 connected to the upper arm 80 of the bell crank lever 82 and tending to urge said bell crank in a clockwise direction, before another sheet S is fed to the collecting cylinder C for collection of another group or stack of sheets.

Rollers 32 are moved to the Fig. 2 position by a mechanism very similar to that just described for moving the members 66. As shown in Figs. 2 and 4, the shaft 34 for each roller 32 is supported by a yoke 100 attached to the end of an arm 102 fixed upon a shaft 104 which is rotatably mounted in the side frame 16, 16. An upwardly extending crank arm 106 is keyed upon the shaft 104 and pivotally connected by means of a link 108 with an upper arm 110 of a bell crank lever 112 similar to the lever 82. Bell crank lever 112 is also pivotally mounted in any convenient manner and has another arm 114 upon which is mounted a cam roller 116 adapted to be actuated by a high point 118 of a cam 120 mounted on the cam shaft 94. High point 118 is substantially identical with high

point 90 of the cam 92 and positioned rotatively to cause the bell crank lever 112 to be moved in a counter-clockwise direction to move the rollers 32 to the Fig. 2 position, at the same time that the members 62 are moved, and to maintain said rollers in the Fig. 2 position until the unloaded group of sheets S is clear thereof. Suitable springs 122 cause the parts associated with the rollers 32 to be moved back to the Fig. 1 position when the roller 116 passes off the high point of the cam 120.

From the description thus far, it will be understood that as the web W is cut into individual sheets S by the operation of the cutter A, the individual sheets S will be gripped between the upper and lower sets of conveyor tapes 28, 18, respectively, of the receiving conveyor R and fed one by one to the collecting cylinder C. Due to the fact that said conveyor tapes 18 and 28 are moving at a surface speed greater, by a predetermined amount, than the speed of the web W, the sheets S will be spaced in their travel from the cutter to the collecting cylinder, the spacing for any size of sheet and speed of operation of the entire apparatus being such that each subsequent sheet will arrive at the collecting cylinder C with its leading edge in register with the leading edges of the sheets which have been collected on said collecting cylinder. This takes place with the parts of the apparatus in the position shown in Fig. 1. When nine sheets have been collected upon the collecting cylinder C and the leading edge of the tenth sheet is in register with the leading edges of the collected sheets, as illustrated in Fig. 3, the cams 92 and 120 will have rotated to a position where the rollers 88 and 116 will be ready to move to the high points 90 and 118, respectively, of said cams. This causes the rollers 32 and the sheet guiding and unloading members 66 to move to the Fig. 2 and 3 positions so that the nine collected sheets and the tenth sheet may be moved from the collecting cylinder to the delivery conveyor D. Movement of the ten sheets from the Fig. 3 position into the delivery conveyor D for subsequent feeding to the delivery table T is caused by the frictional contact of the sheets with the conveyor tapes 28, as they pass around the roller 32, and with the surfaces of the cylindrical sections 48 of the collecting cylinder, and the collected group of ten sheets will pass over the flat guiding surfaces 72 of the members 66 to the delivery conveyor D.

As shown in Fig. 1, the delivery conveyor D comprises a lower set of tapes 124 which have their operative conveying path or reach defined by means of a left-hand set of rollers 126, positioned adjacent the rollers 56 and mounted on the shaft 68, and a right-hand set of guide and/or feed rollers 128 positioned adjacent the delivery table T. The remainder of the path of the endless conveyor tapes 124 is provided by means of sets of guide rollers 130, 132 and 134, any one or all of which may be adjustable to vary the tension in the tapes; all are positioned so that the lower reach of the tapes will pass clear of the cams and cam shaft 94. An upper set of conveyor tapes 136 is cooperatively arranged above the lower tapes 124 and has its operative conveying reach or path defined by a left-hand set of rollers 138, mounted adjacent the rollers 32 and above the rollers 126, and a right-hand set of rollers 140 positioned above the rollers 128. An upper and substantially centrally disposed set of rollers 142 completes the path of the upper set of tapes 136 whose tension may be adjusted by means of suitable adjustable tension rollers 144 mounted on arms 146 attached to a shaft 148 journaled in the side frame 16, 16.

As has been pointed out above, the linear speed of movement of the conveyor tapes 124 and 136 of the delivery conveyor D is determined by the speed of operation of the collecting cylinder C and the number of sheets collected thereon. Since the collecting cylinder C will make, in the instance described herein, nine revolutions before a group of sheets is delivered to the delivery conveyor D and a tenth revolution before starting to collect another group of sheets, the normal surface speed of the conveyor tapes 124 and 136 will be approximately one-tenth that of the surface speed of the collecting cylinder. However, we have found it desirable to increase the speed of the delivery tapes 124 and 136 during that portion of the cycle of operation during which the group of ten collected sheets is fed thereto, at the surface speed of the collecting cylinder and conveyor tapes 28, in order to prevent the sheets from buckling and assure their proper feeding into and reception by said delivery tapes 124 and 136. To accomplish this two speed operation of the conveyor tapes 136 and 124, we have provided the special driving mechanism shown in Figs. 5 and 6 where it will be observed that the rollers 128 are mounted on a shaft 150 on which is mounted a miter gear 152. This miter gear 152 meshes with a miter gear 154 mounted on an auxiliary drive shaft 156 which, through a chain of gears 158, is operatively connected for rotation with a gear 160 mounted on a main drive shaft 162. The speed of rotation of the shaft 162 and the characteristics of the gears 158 are such that shaft 156 will be rotated at the desired normal speed of one-tenth the surface speed of the collecting cylinder C. For example, shaft 162 may be rotated at the increased speed corresponding to the surface speed of the collecting cylinder C and the gears 158 may provide a ten to one reduction so that the shaft 156 will so rotate as to provide a surface speed in the conveyor tapes 124 and 136 which is one-tenth the surface speed of the collecting cylinder C. For increasing the speed of rotation of the shaft 156 when the group of sheets is delivered thereto, said shaft 156 may be provided with a second train of gears 164 which mesh with a normally idling gear 166 mounted on the shaft 162.

A clutch mechanism 168 is provided on shaft 162 to place the chain of gears 166, 164 into operation at the desired time; and a clutch 170 is provided on shaft 156 in association with the chain of gears 158 to disengage said gears when the higher speed is desired. Clutch 170 is disengaged by a movement to the left along the shaft 156 and clutch 168 is engaged with the gear 166 by a movement to the right along the shaft 162. These movements are arranged to take place simultaneously at the same time that the rollers 32 are moved to their upper Fig. 2 position and the guide and unloading members 66 are moved into the grooves 50. This is effected by means of a suitable yoke 172 associated with the clutch 170 and pivotally connected to one arm of a bell crank lever 174. Bell crank lever 174 is pivoted at 176 and has its other arm pivotally connected to one end of an operating link 178 which has its other end provided with a fork 180 slidably engaging a suitable block 182 rotatably mounted on the shaft 94. Operating link 178 is also provided with a cam roller 184 which is adapted to engage a high

point 186 provided on a suitable cam 188 mounted on the cam shaft 94. Clutch 170 is urged into engaging position by means of a suitable spring 190 connected with an arm provided on the bell crank lever 174 and tending to urge it in a counter-clockwise direction.

Similarly, clutch 168 is moved into engagement with the gear 166 by means of a yoke 192 provided thereon and actuated by a lever 194. Lever 194 is mounted on a stub shaft 196 which extends through and is journaled in the side frame 16. A lever arm 198 is mounted on the outside end of the stub shaft 196 and pivotally connected to an operating link 200 similarly to the operating link 178. Operating link 200 is provided with a cam roller 202 which is adapted to engage and be actuated by a high point 204 provided on a cam 206 mounted on the cam shaft 94. Clutch 168 is normally urged into non-engaging position by means of a suitable spring mechanism 208 associated with an arm 210 provided on the shaft 196.

It will be apparent that by the driving means above described for the shaft 150 of the conveyor tape rollers 128, the delivery conveyor D will normally operate at a speed of one-tenth the surface speed of the collecting cylinder C but will be speeded up to have the same surface speed as said collecting cylinder during the portion of the cycle of operation that a group of ten sheets S is fed thereto while the unloading operation of the collecting cylinder C is taking place. Thus, a group of ten sheets collected on the collecting cylinder C will be fed to the delivery conveyor D and the tapes 124 and 136 thereof will be operated at the same surface speed as the collecting cylinder C until said group of sheets is free of the rollers 32. At that time all of the cam rollers 88, 116, 184 and 202 will move off the high points of their associated cams so that the rollers 32 and the guide and unloading members 66 will be moved back to normal Fig. 1 position and the clutch mechanisms will be moved to cause operative engagement of the gears 158 so that the delivery tapes will be reduced in speed to the normal speed of one-tenth the surface speed of the collecting cylinder C. The group of sheets will then be fed at this slower normal speed and discharged at the rollers 128 and 140 upon the delivery table T.

As shown in Fig. 1, the delivery table T comprises a substantially horizontally disposed supporting member 212 which is positioned to the right and beneath the rollers 128 and 140 and provided with suitable adjustable guides 214 for retaining the sheets in proper position thereon. As each group of collected sheets is discharged upon the delivery table T, the sheets are jogged into proper conformed or registered position in the vertically forming stack by means of a rotatably mounted jogging plate 216. This jogging plate 216 may be given a rotating or oscillating movement by means of an operating member 218 which is connected to the upper end of a lever 220. Lever 220 is pivoted substantially at the center thereof to one of the side frames 216 and connected at its lower end by means of a link 222 with a lever arm 224 mounted on a shaft 226. An arm 228 is also mounted on shaft 226 and provided at its outer end with a cam roller 230 which is adapted to be actuated by a suitable cam 232 provided on the cam shaft 94 so as to produce the desired jogging movement of the plate 216 on the delivery table T.

From the foregoing description, it will be apparent that we have provided an improved delivery apparatus which is adapted to handle effectively large thin sheets of paper cut from a web traveling at high speed and to deliver such sheets at greatly reduced speed. While we have described a preferred embodiment of our invention as including cooperating sets of tapes for conveying the sheets and holding them upon the surface of the collecting cylinder, it will be understood that other known types of gripping devices for the sheets may in some instances be employed. Moreover, various other changes may be made in the construction and certain features thereof may be employed without others, without departing from our invention or sacrificing any of its advantages.

What we claim is:

1. A method of delivering at reduced speed a plurality of sheets cut from a web traveling at high speed, which comprises feeding the sheets to a collecting point and there collecting a predetermined number of sheets, discharging the collected group of sheets at a speed substantially equal to the speed of travel of the web, reducing the speed of travel of the discharged group of sheets a predetermined amount, and depositing said discharged group of sheets on a stack at such reduced speed.

2. A method of delivering at reduced speed a plurality of sheets cut from a web traveling at high speed, which comprises feeding the sheets one by one to a rotating collecting cylinder, collecting a predetermined number of sheets on said collecting cylinder and holding the collected group of sheets on said cylinder in conformed relation, unloading the collected group of sheets from said collecting cylinder at a speed substantially equal to the speed of travel of the web, gripping the collected group of sheets while they are being unloaded, reducing the speed of travel of the collected group of sheets by a predetermined amount, and discharging the gripped collected group of sheets at such reduced speed.

3. A method of delivering, at reduced speed and in collected groups of predetermined number, a plurality of sheets cut from a web traveling at high speed, which comprises gripping each sheet as it is cut and feeding it to a collecting cylinder which is rotating at a surface speed at least substantially equal to the speed of travel of the web; collecting in conformed relation on the surface of the collecting cylinder one less than said predetermined number of sheets; when the leading edge of the next sheet is in register with the leading edges of the collected group of sheets, causing the collected group of sheets to be released from the cylinder surface so that they may be fed with said next sheet as a group of predetermined number; gripping said group of predetermined number and feeding them at a speed at least substantially equal to the speed of travel of the web; reducing the speed of travel of said group of predetermined number and discharging them at such reduced speed.

4. Apparatus of the character described comprising the combination with means for cutting a travelling web into individual sheets, of a sheet collecting means, means for gripping the individual sheets as they are cut and feeding them to said sheet collecting means, means for conveying a group of collected sheets from said sheet collecting means to a point of delivery, means for unloading a group of collected sheets from said collecting cylinder and feeding them to said sheet conveying means, means for oper-

ating said sheet collecting means and said sheet gripping and conveying means at a surface speed at least substantially equal to the speed of travel of the web, and means for operating said conveying means at the speed of said sheet collecting means at the time when a group of collected sheets is unloaded, and at a reduced speed at all other times.

5. Delivery apparatus comprising the combination of means for feeding sheets in spaced relation at a predetermined speed of travel; a sheet collecting cylinder having a plurality of spaced annular grooves in the outside surface thereof; sheet guiding and unloading means including a plurality of fingers normally disposed above the surface of said collecting cylinder and adapted to be moved into said annular grooves for removing the sheets collected on said cylinder; and means for moving the fingers of said sheet guiding and unloading means into said annular grooves when a predetermined number of sheets has been collected on said collecting cylinder.

6. Delivery apparatus comprising the combination of means for feeding sheets in spaced relation at a predetermined speed of travel; a sheet collecting cylinder; means for operating said sheet collecting cylinder at such a surface speed that the sheets fed thereto may be collected in a conformed group thereon; means for unloading a collected group of sheets from said collecting cylinder; means positioned adjacent said collecting cylinder for receiving and conveying an unloaded group of sheets to a place of delivery; means for operating said conveying means at a surface speed substantially equal to that of the collecting cylinder during the time that a group of sheets is being unloaded; and means for operating said conveying means at a predetermined reduced speed at the time a collected group of sheets is deposited at the place of delivery.

7. Delivery apparatus comprising the combination of a first substantially horizontally disposed sheet conveying means adapted to receive sheets cut from a traveling web; a sheet collecting cylinder positioned adjacent to and in cooperative relation with said first sheet conveying means for collecting in a conformed group a plurality of sheets which have been conveyed thereto; and a second substantially horizontally disposed sheet conveying means positioned adjacent to said collecting cylinder and adapted to receive collected groups of sheets therefrom and deliver them at reduced speed.

8. Delivery apparatus comprising the combination of a first substantially horizontally disposed sheet conveying means adapted to receive sheets cut from a traveling web; a sheet collecting cylinder positioned adjacent to and in cooperative relation with said first sheet conveying means for collecting in a conformed group a plurality of sheets which have been conveyed thereto; a delivery table in alignment with and spaced from said sheet collecting cylinder; and a second substantially horizontally disposed sheet conveying means positioned between said sheet collecting cylinder and said delivery table and adapted to receive collected groups of sheets from said collecting cylinder and deposit them on said delivery table.

9. Delivery apparatus comprising the combination of a first substantially horizontally disposed sheet conveying means adapted to receive sheets cut from a traveling web; a sheet collecting cylinder positioned adjacent to and in cooperative relation with said first sheet conveying means for collecting in a conformed group a plurality of sheets which have been conveyed thereto; a delivery table in alignment with and spaced from said sheet collecting cylinder; a second substantially horizontally disposed sheet conveying means positioned between said sheet collecting cylinder and said delivery table and adapted to receive collected groups of sheets from said collecting cylinder and deposit them on said delivery table; and means for operating said second sheet conveying means normally at a slow surface speed and increasing the speed to that of the collecting cylinder during the time that a collected group of sheets is being unloaded

10. Delivery apparatus comprising the combination of a first substantially horizontally disposed sheet conveying means adapted to receive sheets cut from a traveling web; a sheet collecting cylinder positioned adjacent to and in cooperative relation with said first sheet conveying means for collecting in a conformed group a plurality of sheets which have been conveyed thereto; a delivery table in alignment with and spaced from said sheet collecting cylinder; a second substantially horizontally disposed sheet conveying means positioned between said sheet collecting cylinder and said delivery table and adapted to receive collected groups of sheets from said collecting cylinder and deposit them on said delivery table; and means for unloading collected groups of sheets from said sheet collecting cylinder and guiding them to said second sheet conveying means.

11. Delivery apparatus comprising the combination of means for feeding sheets in spaced relation at a predetermined speed of travel; a sheet collecting cylinder having tapes associated therewith for holding sheets in contact with the surface thereof; means for operating said sheet collecting cylinder and its associated tapes at such a surface speed that the sheets fed thereto may be collected in a conformed group thereon; guiding and unloading means cooperating with said collecting cylinder and adapted to be moved to a position which will cause a collected group of sheets to be unloaded from said collecting cylinder; and means for moving said sheet guiding and unloading means to unloading position when a predetermined number of sheets has been collected on said collecting cylinder.

12. Delivery apparatus comprising the combination of means for feeding the sheets in spaced relation at a predetermined speed of travel; a sheet collecting cylinder; a feed roller for cooperating with said sheet collecting cylinder for insuring the proper feeding of sheets thereto and collection of sheets thereon; means for operating said sheet collecting cylinder at such a surface speed that the sheets fed thereto may be collected thereon in a conformed group; guiding and unloading means cooperating with said collecting cylinder and adapted to be moved to a position which will cause a collected group of sheets to be unloaded from said collecting cylinder; and means for moving said feed roller out of contact with said collecting cylinder and moving said sheet guiding and unloading means to unloading position when a predetermined number of sheets has been collected on said cylinder.

13. Delivery apparatus comprising the combination of means for feeding sheets in spaced relation at a predetermined speed of travel; a sheet collecting cylinder having a plurality of

spaced annular grooves in the outside surface thereof; a feed roller cooperating with said sheet collecting cylinder at the point at which the sheets are fed thereto; sheet guiding and unloading means including a plurality of fingers normally disposed above the surface of said collecting cylinder and adapted to be moved into said annular grooves for removing the sheets collected on said cylinder; and means for moving said feed roller out of contact with said sheet collecting cylinder and moving the fingers of said sheet guiding and unloading means into said annular grooves when a predetermined number of sheets has been collected on said collecting cylinder.

14. Delivery apparatus comprising the combination of means for feeding sheets in spaced relation at a predetermined speed of travel; a sheet collecting cylinder; means for operating said sheet collecting cylinder at such a surface speed that the sheets fed thereto may be collected in a conformed group thereon; means for unloading a collected group of sheets from said collecting cylinder; means positioned adjacent said collecting cylinder for receiving and conveying an unloaded group of sheets to a place of delivery; means for normally operating said conveying means at a predetermined slow speed; and means for simultaneously moving the unloading means to sheet removing position and operating said conveying means at an increased surface speed which is substantially equal to that of the collecting cylinder during the time a group of sheets is being unloaded.

15. Delivery apparatus comprising the combination of means for feeding sheets in spaced relation at a predetermined speed of delivery; a sheet collecting cylinder; feeding means cooperating with said sheet collecting cylinder at the point at which the sheets are fed thereto; means for operating said sheet collecting cylinder at such a surface speed that the sheets fed thereto may be collected in a conformed group; means for unloading a collected group of sheets from said collecting cylinder; means positioned adjacent said collecting cylinder for receiving and conveying an unloaded group of sheets to a place of delivery; means for normally operating said conveying means at a predetermined surface speed substantially slower than that of the collecting cylinder; and means for simultaneously moving said feeding means to an inoperative position, moving the unloading means to an operative position for unloading a collected group of sheets, and causing said conveying means to be operated at an increased surface speed which is substantially equal to that of the collecting cylinder when a predetermined number of sheets has been collected on said collecting cylinder.

ARTHUR P. BAMFORD.
JOHN T. RITZAU.

CERTIFICATE OF CORRECTION.

Patent No. 2,278,188. March 31, 1942.

ARTHUR P. BAMFORD, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 6, second column, line 16, claim 9, after "unloaded" insert the word and period --thereon.--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 29th day of September, A. D. 1942.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)